Abused-Drug Testing : their Uses & Limitations

Applications

- Judiciary
  - Offenders placed on probation
  - Inmates under drug treatment program
  - Prisoners under custody
- Medical
  - Emergency
  - Therapeutic drug monitoring
- Schools
- Workplace
- Sports

Abused-Drugs to be tested

- Benzodiazepines
- Cannabinoids
- Cocaine
- Codeine
- Heroin
- Ketamine
- MDMA
- Methamphetamine

Testing Technologies

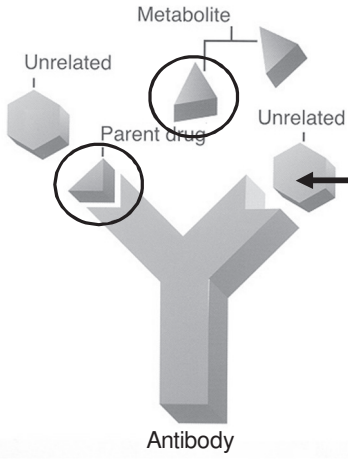
Testing technology - Screening

- By immunoassay
  - On-site testing
  - Laboratory-based testing
- "Cutoff" level
  - > or = threshold level ➔ **POSITIVE**
    - Subjected to further confirmatory testing for unequivocal proof
  - None or < threshold level ➔ **NEGATIVE**
- **POSITIVE**
  - Indicating recent drug consumption
- **NEGATIVE**
  - No indication of recent drug consumption
- May give false positive results (cross-reactivity)

Screening Test (Immunoassay)

- Interaction between Antibodies and Drugs
- Test for a class of drugs with similar chemical structure
- False-positive result may arise due to cross-reactivity
- Give presumptive test results
- Quick, inexpensive, but less specific
- Screening by instruments
  - High throughput
  - Semi-quantitative determination
  - Printout records

Immunoassay mechanism



ANTIBODY interacts with:
Parent drug & Metabolite

Unrelated antigen leading to false positive result (cross reaction)

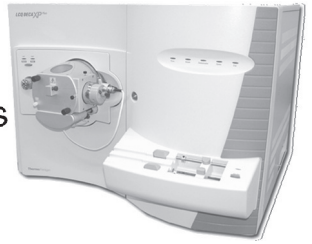
'Lock' and 'Key' mechanism

Screening tests

- Amphetamines
  - Cross-reacted by
    - Cardiac drugs
    - Mental drugs
    - Slimming drugs
- Opiates
  - Cross-reacted by
    - Some cough medicines
- Cannabinoids
  - Unlikely to be cross-reacted
- Benzodiazepines
  - Less likely to be cross-reacted
- Ketamine
  - Unlikely to be cross-reacted

Testing technology - Confirmation

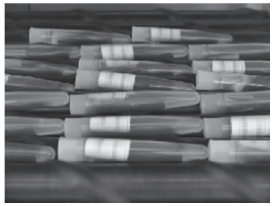
- Must be laboratory-based
- Using sophisticated instruments (chromatography-mass spectrometry)
- Operated by trained personnel
- Specific, but expensive and time consuming
- Accurate and unequivocal results

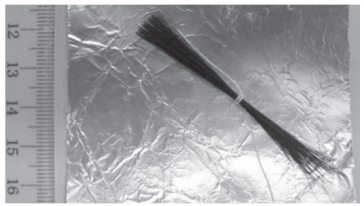


Specimens for Testing

Specimens for testing

- Invasive sampling
  - Blood
  - Urine
- Non-invasive sampling
  - Hair
  - Saliva
  - Sweat



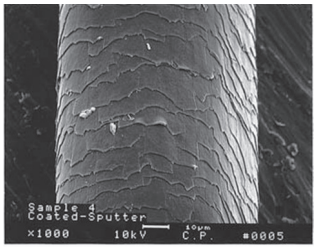


Window of detection

BLOOD / SALIVA	Hours
URINE	Days
SWEAT	Days to week
HAIR	Months to year

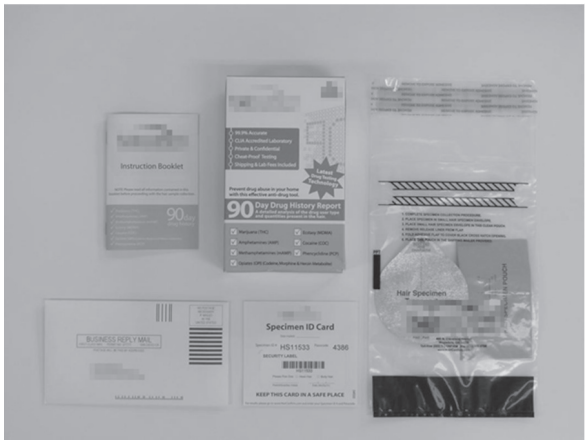
Hair testing

- Laboratory-based testing
- Expensive and time consuming
- Test for chronic abuse history of a donor
  (head hairs grow at about 1cm/month)
- Specimen collection – non-invasive
  - Hair collected near the scalp
  - Typically 100 mg needed
- Good drug stability in hair
- Difficult to tamper

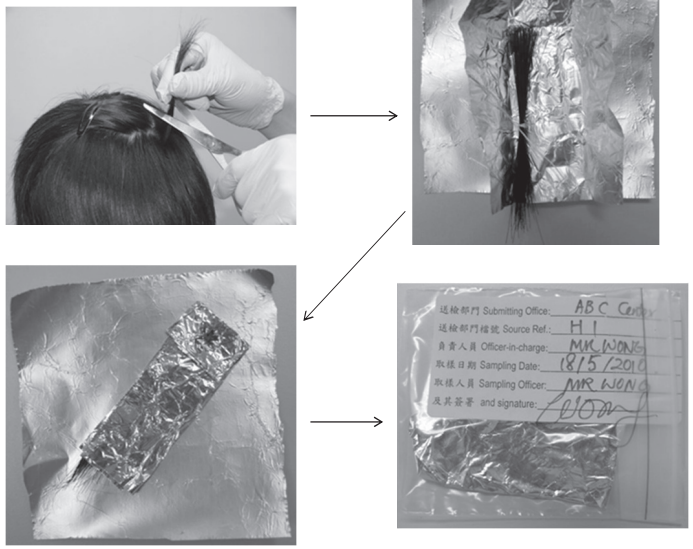


Hair testing

- Hair follicle multi-drug test kit (7 classes of drugs)



Hair testing



Sweat patch testing

- Laboratory-based test only
- Cumulative test : long detection window (2 weeks)
- Contamination issue
- Irritation issue
- Not popular

Urine testing

- Aim
  - To determine any recent consumption of drugs by the donor
- Window of detection
  - 1-3 days for most drugs
  - Up to 14 days for chronic cannabis abusers
- Inexpensive, reliable results
- Testing – on-site or laboratory-based
- Urine sample
  - Large specimen volume
  - Relatively high drug concentration (10-100 times more than that in oral fluid)
- Susceptible to tampering

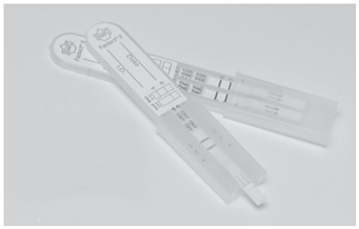
Window of detection

Amphetamines	**1-3 days**
Benzodiazepines	**1 day (short-acting)** **3 days (long-acting)**
Cannabinoids	**2-7 days (1 joint)** **2-10 weeks (5 joints)**
Cocaine	**2 days**
Methadone	**2-4 days**
Heroine / Codeine	**1-2 days**

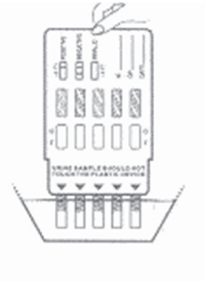
Urine Testing Devices in the Market

- Dipstick
  - dip the device directly into urine
  - for small number of tests (1-2 tests)
- Dipcard
  - dip the device directly into urine
  - for larger number of tests (5-10 tests)
- Cassette
  - urine sample dropped into the device
- Cup
  - Collects, tests and transports urine

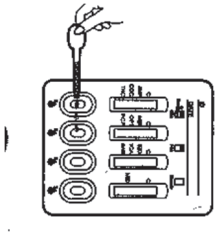
Dipstick



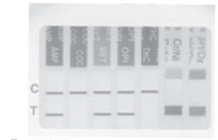
Dipcard



Cassette



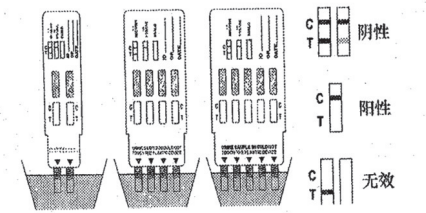
Cup

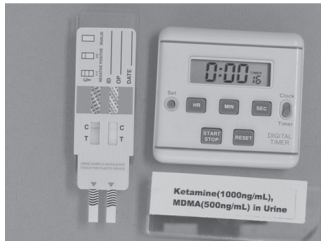


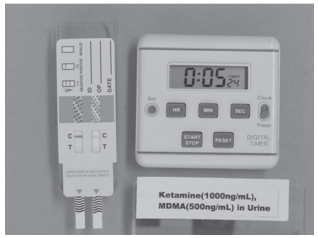
Example Interpretation:

AMP: Negative
COC: **Presumptive Positive**
MET: Negative
OPI: Negative
THC: **Presumptive Positive**

Dipstick for Ketamine & MDMA Testing





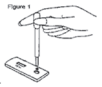


Cassette for Ketamine Testing

ASSAY PROCEDURE

1. Bring the test components and urine sample to room temperature (15° -28o C) before testing.

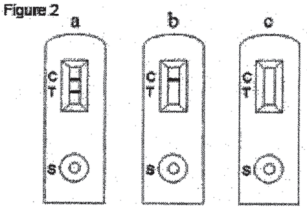
Figure 1

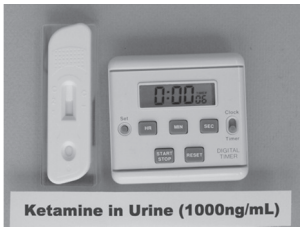


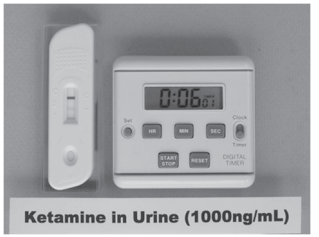
Do not open the foil pouch until ready to begin testing.

2. Open the foil pouch at the notch and remove the test device and dropper prior to testing. Place the device on a clean, level surface.
3. Hold the dropper vertically and dispense 2 drops (~ 70 ml) of urine sample without air bubbles into the sample well "S" of the test device (Figure 1).
4. Read test results between 3 - 8 minutes. **Do not interpret results after 8 minutes.** IMPORTANT: Waiting more than 8 minutes before reading the test result may cause the test result to be inaccurate.

Figure 2







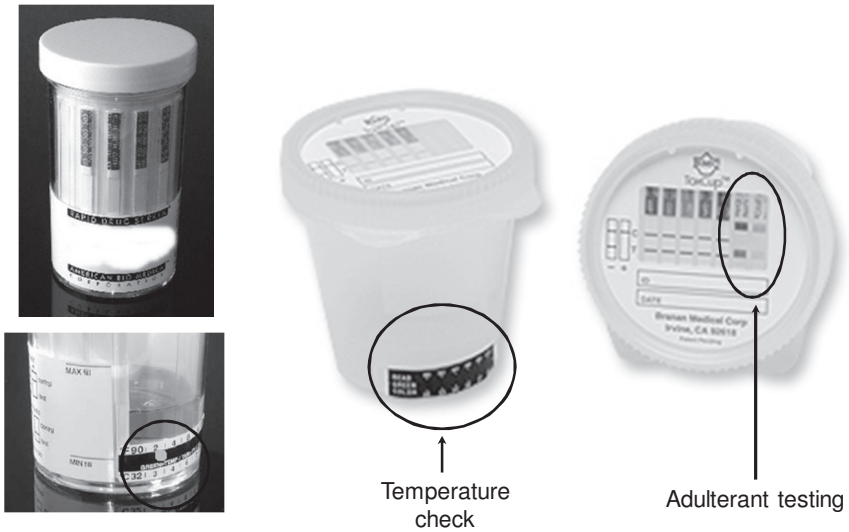
Tampering in Urine Testing

- Dilution
  - Consumption of large amount of water to reduce the urine drug concentration below cut-off level
- Substitution
  - Purchase synthetic urine
  - Use other's clean urine
  - Use animal urine
- Adulteration
  - Adulterants from household / commercial source
    - Bleach
    - Acid
    - Oxidizers

Test Strip for Detecting Tampering

- Effective testing on the integrity of donor's urine
  - Against dilution
  - For oxidizers
  - For acid/alkali
  - For bleach
  - For vinegar
  - For hand soap

Built-in anti-tampering devices



Oral fluid (Saliva) Testing

- Testing – on-site or laboratory-based
- Closely mimics results found with blood test
- Sampling
  - Non-invasive
  - Little chance of tampering
- Less effective in detecting cannabis abuse
- More expensive than urine testing
- Not so widely accepted as urine testing
- For drug-driving enforcement overseas

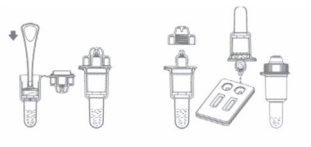
Oral Fluid Testing Kits in Market

- Separate collection and testing device
  - Collecting device with absorbent pad
  - Testing cassette
- Integrated collection and testing device
  - Collection pad and testing device in a unit
- Reader available as an optional accessory
  - Objective measurement by electronic reader
  - Recording time, date, donor's name and results

Separate collection and testing device








Integrated collection and testing device

Reader : an optional accessory



Trends in Abused-Drug Testing

- On-site urine testing gaining popularity
  - More scientific studies
  - Longer track record
  - Increasing utilization, more products in the market
  - Lower price
- Test cup devices
  - Convenient
  - Reduce biohazard
- Anti-tampering testing might be a necessity
- Oral fluid as a complementary specimen
  - Shorter window of detection than urine
  - Higher cost
  - Need further study on cutoff concentrations
  - Need more studies